

WHAT IS CLAIMED IS:

1. An image processing method comprising:
  - a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;
  - a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;
  - 10 an inverted image creating step of creating an inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;
  - 15 a second pixel block sampling step of sampling white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and
  - a tree structure addition step of adding data regarding the white pixel blocks and black pixel blocks sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.
- 25 2. The image processing method according to claim 1, wherein for the data regarding the white pixel blocks and black pixel blocks added in said

tree structure addition step, data regarding white pixel blocks having data regarding the sampled black pixel blocks as child nodes is added as child nodes of the white-black-inverted black pixel blocks of  
5 said tree structure data.

3. The image processing method according to claim 1, wherein in said inverted image creating step, said inverted image is created by white-black  
10 inverting the pixels inside the black pixel blocks sampled in said first pixel block sampling step with the outline of the black pixel blocks constituted by black pixels.

15 4. The image processing method according to claim 1, further comprising an area division step of dividing said binary image into a plurality of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel blocks  
20 and black pixel blocks added in said tree structure addition step.

25 5. The image processing method according to claim 1, further comprising an area tree structure creating step of creating area tree structure data indicating a positional relation between a plurality of areas by grouping black pixel blocks based on the

tree structure data with data regarding white pixel blocks and black pixel blocks added in said tree structure addition step.

5       6. The image processing method according to  
claim 1, wherein said black pixel block is an area  
surrounded by a black pixel outline obtained by  
performing eight direction outline tracking of black  
pixels, and said white pixel block is an area  
10 surrounded by white pixel outline obtained by  
performing four direction outline tracking of white  
pixels.

7. The image processing method according to  
15 claim 1, wherein said binary image is an image  
obtained by subjecting a binary original image to OR  
scaledown, and

      said inverted image is created based on the  
area of black pixel blocks to be white-black-inverted  
20 and an image obtained by white-black inverting said  
original image and subjecting the same to OR  
scaledown.

8. The image processing method according to  
25 claim 1, wherein in said inverted image creating step,  
an inverted image for black pixel blocks of low black  
pixel density, of black pixel blocks included in said

tree structure data, is not created.

9. The image processing method according to  
claim 1, wherein the black pixel blocks sampled in  
5 said second pixel block sampling step are black pixel  
blocks remaining after removing black pixel blocks  
sampled from said inverted image that are located at  
positions corresponding to white pixel blocks each  
having a predetermined size or greater size, of white  
10 pixel blocks sampled from said binary image, from a  
plurality of black pixel blocks sampled from said  
inverted image.

10. The image processing method according to  
15 claim 1, wherein in said second pixel block sampling  
step, it is determined that black pixel blocks from  
which the inverted image is created include no  
inverted characters to end processing if the ratio of  
black pixel blocks originating from noises to a  
20 plurality of black pixel blocks extracted from said  
inverted image equals a predetermined value or  
greater value.

11. The image processing method according to  
25 claim 7, wherein said binary original image is an  
image converted by binarizing a multi-valued original  
image.

12. An image processing apparatus comprising:
  - first pixel block sampling means for recursively sampling black pixel blocks and white pixel blocks from a binary image;
  - 5 tree structure creating means for creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled by said first pixel block sampling means;
  - inverted image creating means for creating an 10 inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;
  - second pixel block sampling means for sampling 15 white pixel block and black pixel blocks from the inverted image created by said inverted image creating means; and
  - tree structure addition means for adding data regarding the white pixel blocks and black pixel 20 blocks sampled by said second pixel block sampling means to corresponding nodes of said tree structure data.
13. The image processing apparatus according to 25 claim 12, wherein for the data regarding the white pixel blocks and black pixel blocks added by said tree structure addition means, data regarding white

pixel blocks having data regarding the sampled black pixel blocks as child nodes is added as child nodes of the white-black-inverted black pixel blocks of said tree structure data.

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14. The image processing apparatus according to claim 12, wherein said inverted image creating means creates said inverted image by white-black inverting the pixels inside the black pixel blocks sampled by 10 said first pixel block sampling means with the outline of the black pixel blocks constituted by black pixels.

15. The image processing apparatus according to 15 claim 12, further comprising area division means for dividing said binary image into a plurality of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel blocks and black pixel blocks added by said tree structure 20 addition means.

16. The image processing apparatus according to claim 12, further comprising area tree structure creating means for creating area tree structure data indicating a positional relation between a plurality 25 of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel

blocks and black pixel blocks added by said tree structure addition means.

17. The image processing apparatus according to  
5 claim 12, wherein said black pixel block is an area surrounded by a black pixel outline obtained by performing eight direction outline tracking of black pixels, and said white pixel block is an area surrounded by white pixel outline obtained by  
10 performing four direction outline tracking of white pixels.

18. The image processing apparatus according to  
claim 12, wherein said binary image is an image  
15 obtained by subjecting a binary original image to OR scaledown, and  
said inverted image is created based on the area of black pixel blocks to be white-black-inverted and an image obtained by white-black inverting said  
20 original image and subjecting the same to OR scaledown.

19. The image processing apparatus according to  
claim 12, wherein said inverted image creating means  
25 does not create an inverted image for black pixel blocks of low black pixel density, of black pixel blocks included in said tree structure data.

20. The image processing apparatus according to  
claim 12, wherein the black pixel blocks sampled by  
said second pixel block sampling means are black  
pixel blocks remaining after removing black pixel  
5 blocks sampled from said inverted image that are  
located at positions corresponding to white pixel  
blocks each having a predetermined size or greater  
size, of white pixel blocks sampled from said binary  
image, from a plurality of black pixel blocks sampled  
10 from said inverted image.

21. The image processing apparatus according to  
claim 12, wherein said second pixel block sampling  
means determines that black pixel blocks from which  
15 the inverted image is created include no inverted  
characters to end processing if the ratio of black  
pixel blocks originating from noises to a plurality  
of black pixel blocks extracted from said inverted  
image equals a predetermined value or greater value.  
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22. The image processing apparatus according to  
claim 18, wherein said binary original image is an  
image converted by binarizing a multi-valued original  
image.

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23. A computer executable image processing  
program comprised of codes for making a computer

perform:

a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;

5 a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;

10 an inverted image creating step of creating an inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;

15 a second pixel block sampling step of sampling white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and

20 a tree structure addition step of adding data regarding the white pixel blocks and black pixel blocks sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.

24. A storage medium including a computer readable image processing program, the image processing program comprised of codes for making a computer perform:

a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;

5 a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;

10 an inverted image creating step of creating an inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;

15 a second pixel block sampling step of sampling white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and

20 a tree structure addition step of adding data regarding the white pixel blocks and black pixel blocs sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.